Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Rain Gauge Pairs MC3E V2

Introduction

The GPM Ground Validation Rain Gauge MC3E V2 data were collected during the Mid-latitude Continental Convective Cloud Experiment (MC3E) using 16 tipping bucket precipitation gauges from April to June 2011 in central Oklahoma near the ARM Southern Great Plains Central Facility. The gauges were deployed alongside Autonomous Parsivel Units (APU) to directly measure precipitation amounts. The overarching goal of the MC3E campaign was to provide the most complete characterization of convective cloud systems, precipitation, and the environment ever obtained and to provide new constraints for model cumulus parameterizations and space-based rainfall retrieval algorithms over land. The data set contains two ASCII files per rain gauge with two rain gauges on each station platform. The gag dataset is quality-controlled reformatted precipitation recorded in millimeters at a temporal resolution of 1 minute and the gmin dataset contains cubic spline interpolated rain rates in millimeters per hour at 1 minute resolution.

Notice:
This version 2 data set is an updated MC3E rain gauge product with completely different file format and data structure than version 1, which was published in 2011. Some of the information included in the version 1 data set files are no longer included.

Citation

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Keywords:

NASA; GHRC; MC3E; GPM GV; Oklahoma; rain gauges; tip bucket; cubic spline; precipitation; precipitation amount; precipitation rate;

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation (GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint-agency/ international external field campaigns, using state of the art cloud and precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV. More information about the GPM mission is available at http://pmm.nasa.gov/GPM.

The Midlatitude Continental Convective Clouds Experiment (MC3E) was a GPM GV field campaign which took place in central Oklahoma during April-June 2011. MC3E used a multi-scale observing strategy with the participation of a network of distributed sensors (both passive and active). The objective was to document and monitor in 3D not only precipitation, but also clouds, winds, and moisture in an attempt to provide a holistic view of convective clouds, their environment, and any associated feedbacks. The experiment was a collaborative effort between the U.S. Department of Energy (DOE), Atmospheric Radiation Measurement (ARM), Climate Research Facility, and the National Aeronautics and Space Administration's (NASA) GPM GV program and consisted of measurements from the observing infrastructure currently available in the central United States, an extensive set of sounding array, remote sensing, and in situ aircraft observations, data from the NASA GPM GV remote sensors, and a new ARM instrumentation purchased with American Recovery and Reinvestment Act funding. The measurements have provided newly available constraints for model cumulus parameterizations and space-based rainfall retrieval algorithms over land. Further details on GPM MC3E are available at http://gpm.nsstc.nasa.gov/mc3e/. Information on ARM MC3E is available at http://www.arm.gov/campaigns/mc3e/.

This MC3E rain gauge dataset contains precipitation data from rain gauges distributed throughout the MC3E study area located within a radius of approximately 6 km of the ARM Southern Great Plains Central Facility. The rain gauges were placed adjacent to APU.

Instrument Description

The rain gauges used are manufactured by Met One Instruments, Inc. and Campbell Scientific Corp. These are self-emptying, tipping bucket gauges that measure the amount of fallen precipitation (rain and/or snow). There are two sizes of gauge within the dataset, one has a 20.3cm (8 inch) diameter catchment funnel that directs precipitation to a tipping bucket assembly and the other has a 30.5cm (12 inch) diameter catchment funnel. For each gauge, when 0.254mm (0.01 inch) of liquid water is collected, the tipping bucket assembly tips, draining the collection and activating a mercury switch for recording the

data. There are two rain gauges located on each station platform as shown in the figure below.

More detailed information on the Met One Precipitation Gauge is available at http://www.metone.com/docs/370_380_precipitation_gauge.pdf

More detailed Information on the Campbell Scientific gauge can be found at https://s.campbellsci.com/documents/us/product-brochures/b_385.pdf

Fig 1: Dual tipping rain gauge bucket used for GPM-GV
(image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

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File Naming Convention

The GPM Ground Validation Rain Gauge Pairs MC3E data set consists of ASCII text (.txt) files. The files are named with the following convention:

mc3e_raingauge_APU##_X_[YYYYMMDD_start]_[YYYYMMDD_end]_[gag|gmin].txt

Table 1: File naming convention variables

Variable	Description
APU##	Station identifier - The gauges were placed adjacent to Autonomous Parsivel Units (APU)
X	Rain gauge letter (A or B) equipped on each platform
YYYYMMDD_start	YYYY = year, MM = month of year, DD = day of month
YYYYMMDD_end	YYYY = year, MM = month of year, DD = day of month
gmin	Cubic spline interpolated 1-hour rain rates (mm/h) with 1-minute resolution calculated using the algorithm of Wang et al. 2008 (See References)
gag	Quality controlled reformatted rainfall data (mm) with a resolution of 1 minute

The two file types contain measurements of fallen precipitation at recorded points in time and cubic spline interpolated rain rates during the study period, April to June 2011. There are two files per each rain gauge and two rain gauges associated with each APU location.

Data Format Description

This data product contains text format data files organized by station and rain gauge. Two types of files exist for each gauge, one gag and one gmin. Each text file contains two header lines followed by the station data. The files contain non-zero rainfall data only and therefore are not a complete time series.

The first header line contains the data year, field program, gauge identification number, gauge maker and bucket resolution. The second header line contains the column headers for each file type.
For GAG files:
year, month, day of the month, Julian day of the year, hour, minute, second, rain rate (mm), latitude and longitude.
For GMIN files:
year, month, day of the month, Julian day of the year, hour, minute, interpolated one-minute rain rate (in mm/hr), latitude and longitude.

Table 2: Data Characteristics

Characteristic	Description
Platform	GPM Ground Validation NASA Rain Gauge Pairs MC3E
Instrument	Met One or Campbell Scientific Rain Gauges
Projection	n/a
Spatial Coverage	Each station is at a specific geographic location, collectively the data set covers an area encompassing 36.56 to 36.64 deg latitude and -97.43 to -97.53 deg longitude, or an area located within a radius of approximately 6 km of the ARM Southern Great Plains Central Facility
Spatial Resolution	Point source
Temporal Coverage	22 April to 06 June 2011
Temporal Resolution	1 minute
Sampling Frequency	1 minute
Parameter	Precipitation, precipitation amount, precipitation rate
Version	2
Processing Level	2

Data Parameters

There are two rain values associated with this data product each in separate files. The tipping bucket rain gauge rainfall values (mm) are in the gag files and the cubic spline interpolated hourly rain rates (mm/hr) provided at 1-minute intervals are in the gmin files. The latitude and longitude of each rain gauge is provided in the file. Each station platform has two gauges as shown in Fig. 1, which are referred to as gauge A or B. There is a set of files (gmin and gag) for each gauge.

Algorithm

To create a quasi-continuous time series of 1-minute interval hourly rain rates, a cubic spline algorithm is used to interpolate the measured gauge data. The algorithm is described in Wang et al 2008.

Quality Assessment

The rain gauges have a reported accuracy of ±0.5% at 13 mm/hr and ±1% at 25 - 75 mm/hr. Errors in tipping bucket rain gauge measurements have been reported in Ciach, 2003; Tokay et al., 2010; Wang et al., 2008; Wang et al., 2010; Wang et al., 2012.

References

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